WSDOT WETLAND MITIGATION SITES

OLYMPIC REGION

MONITORING REPORT

Monitoring Staff

Fred Bergdolt
Paul Dreisbach
Jim Lynch
Cyndie Prehmus
Bob Thomas
Hilton Turnbull

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Washington State Department of Transportation

Environmental Affairs Office

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INTRODUCTION

History

The Washington State Department of Transportation (WSDOT) facilitates responsible implementation of transportation services, in part by providing leadership to foster environmental stewardship. WSDOT strictly adheres to all applicable federal, state and local environmental regulations, including the Clean Water Act and the state "no net loss" policy for wetlands (Executive Order 1989).

Infrastructure improvements have accompanied economic and population growth in the state of Washington. WSDOT routinely evaluates the potential for degradation of critical areas resulting from infrastructure improvements. Generally, mitigation sites are planned when transportation improvement projects affect critical areas. Monitoring provides a means to track the status and development of these mitigation sites. These sites are monitored by the WSDOT Wetland Monitoring Program. Beginning with six sites in 1988, the number of sites monitored annually has grown steadily. Fifty-one sites were monitored in 2000 (Figures 1 and 2).

Purpose

The purpose for this document is to report the status of WSDOT mitigation sites as observed in 2000. Permit compliance and the development of wetland characteristics are addressed as appropriate. We rely on feedback from the users of this report to ensure its contents are clear, concise and meaningful.

Process

Site monitoring typically begins in the first spring after the site is planted. Sites are monitored for the time period designated by the permit or mitigation plan. The monitoring period generally ranges from three to ten years. Monitoring activities may vary depending on site and permit requirements, stage of site development, and other factors.

Data are collected on a variety of site parameters including vegetation, hydrology, and wildlife. Monitoring activities are driven by site-specific success standards detailed in the mitigation plan. Analysis of monitoring data provides information for an evaluation of site development and permit compliance.

Monitoring data has several intended uses, including the following. The monitoring program staff use results from data analysis to communicate issues related to site development and to report compliance to permit success standards to regional staff and permitting agencies. Regional staff uses data provided by the monitoring team to plan appropriate maintenance and remediation activities. Permitting agencies use the data to track and document compliance.

Methods

Methods used for mitigation site monitoring have changed as site requirements and customer needs have evolved. Our historical data collection methods are described in the ***Guide for Wetland Mitigation Project Monitoring*** (Horner and Raedeke 1989). These methods were initially adopted as a standardized set of protocols, with vegetation, hydrology, soil, wildlife and benthic macroinvertebrate data collected on every site, every year.

As the number of sites being actively monitored increased, these standardized protocols have been modified. During this period, program staff began to evaluate monitoring methods used by other groups and agencies. This effort led to a major change in the methods used to monitor WSDOT mitigation sites. The data collection techniques currently in use include standard ecological and biostatistical methods.[1]

There are several important differences between our historical and current monitoring methods. Brief descriptions of these changes follow.

Objective-based monitoring: Instead of routinely collecting data for a wide range of environmental parameters, we presently collect data using a monitoring plan and sampling design developed specifically for that site. The monitoring plan and sampling design address individual requirements such as success standards, site development, invasive species, and other considerations as required.

Adaptive management: Monitoring is a critical component of the adaptive management process, driven by site-specific management objectives that describe a desired condition (Elzinga et al. 1998). Through appropriate sampling design and collection of valid data, monitoring determines if the objectives have been achieved. Monitoring provides the link between objectives and management activities. Without valid data to accurately identify deficiencies, appropriate corrective management activities cannot be conducted. Alternately, with poor data, unnecessary management may occur.

Statistical rigor: In the analysis of biological data it is common to discover that too few data were collected for reliable conclusions to be drawn (Krebs 1999; Zar 1999). In addition, data must be collected using some type of random sampling procedure (Elzinga 1999). The monitoring program presently uses a variety of tools to remove subjectivity from data collection and to increase the reliability of our results. Our goal is to provide customers with an objective evaluation of site conditions based on valid monitoring data.

[1] New methods combine changes in sampling design with rigorous statistical analysis to more accurately portray vegetative development on mitigation sites. New methods are based on techniques described in Bonham (1989), Elzinga (1998), Krebs (1999), Zar (1999), and other sources.

Success standards: An important element in any mitigation plan is the objectives and success standards (Ossinger 1999). They serve to indicate the desired state or condition of the mitigation site at a given point in time. Some also provide contingencies if a specific condition is met, such as low aerial cover of woody species or exceeding a threshold of invasive species.

Monitoring program staff use the success standards and contingencies as the basis for establishing management objectives for each site. Management objectives are derived directly from the success standards contained in the mitigation plan and/or site permit. In this process, the goals, objectives, and standards for success and site permit are carefully examined to understand the intended site attributes or characteristics. Each management objective contains six required elements; species indicator, location, attribute, action, quantity/status, and time frame (Elzinga 1999). These elements help describe the desired site condition.

Many management objectives require a companion sampling objective. When the management objective identifies a threshold, such as aerial cover or survival rate, the sampling objective includes a confidence level and confidence interval half width.[2] These are noted as (CI = X ± Y), where CI = confidence interval, X = confidence level, and Y = confidence interval half width. For example, should you see an estimated aerial cover of herbaceous species shown as 65% (CI = 0.80 ± 0.20) in a report, this means that we are eighty percent confident that the reported value is within twenty percent of the true value. In this case, our estimated value is sixty-five percent, and we are eighty percent confident the true aerial cover value is between seventy-eight percent and fifty-two percent.

Two examples of how these will appear in the report follow:

From the Mitigation Plan or Permit:

Success Standard Upland and riparian forested buffer areas should have 50% cover by forested species planted, or be supplemented or replaced by a native naturally colonizing upland forested plant community at 50% or greater cover.

Derived from the Mitigation Plan or Permit:

Management Objective

Achieve 50% aerial cover of forested and scrub-shrub species in the riparian buffer on the SR 18 Issaquah-Hobart mitigation site by 2001.

[2] The confidence level indicates the probability that the confidence interval includes the true value. The confidence interval half width will decrease as the confidence level decreases (Elzinga 1998).

Companion to the Management Objective:

Sampling Objective 2

To be 80% confident the mean aerial cover estimate for forested and shrub species in the riparian buffer is within 20% of the true cover value.

From the Mitigation Plan or Permit:

Contingency Plan

The mitigation plan is designed to use and promote the growth of native vegetation. Attempts will be made to limit the spread of exotic species, which will not be allowed to dominate the site. Noxious weeds will be eliminated immediately if found occurring on the site, before large populations can establish. A weed control program will be implemented if more than 5% of the coverage in the wetland is deleterious exotic species.

Derived from the Contingency Plan:

Management Objective

To maintain the combined level of deleterious exotic species at $\leq 5\%$ aerial cover at the Profitt's Point mitigation site in each year of the monitoring period (2000-2005).

Companion to the Management Objective:

Sampling Objective 3

To be 80% confident that the aerial cover estimate for the combined level of deleterious exotic species is within $\pm$ 20% of the true value.

Mitigation plans and permits frequently contain success standards that are not measurable. One example of this is attempting to measure the survival of woody species in the third year of monitoring. Wetlands are highly productive systems that produce substantial biomass. In most cases, planted woody species that have died cannot be reliably located after three years, and usually will have decayed beyond recognition as a planted species. **Success standards that are not measurable or do not apply to the current year's activities do not have management or sampling objectives in this report.**

The management objectives, sampling objectives, and the success standard from which they were derived are in the text of each site report. The complete objectives and success standards from the mitigation plan for that site are in the appendices of each report.

Intensity of Monitoring

Monitoring is conducted primarily for two purposes (Elzinga et al. 1998). One is to detect biologically significant changes in abundance, condition, or population structure. Estimates of aerial cover and survival of plantings are examples of attributes that can be

measured to detect biologically significant change. The other purpose is to understand the effects of management activities on ecosystems or plant communities.

Parameters for monitoring activities are grouped into two levels, qualitative or quantitative, based on the level of effort or intensity of data collection. Qualitative techniques are generally less intensive than quantitative techniques (Elzinga et al. 1998). Qualitative monitoring provides general information such as presence or absence of specific plant species, hydrology indicators, or assessment of site conditions. Also, photographs are generally taken to document current site conditions. A library of site photographs is available in the program office.

Quantitative monitoring provides information on aerial cover, condition, or site characteristics. Random sampling methods are required to produce a statistically credible estimate of a characteristic when only a portion of a site is sampled (Zar 1999). When practical, a total census gives an accurate count of the population rather than an estimate. A variety of methods and tools are used to collect quantitative data, including the line intercept method (Canfield 1941; Bonham 1989), the point intercept method (Bonham 1989; Elzinga et al. 1998), point-intercept devices, point frames, and others. A detailed description of the specific data collection methods used is included in each site report.

The requirements within the permits and mitigation plan can adequately be addressed qualitatively in some years, and in others, quantitative monitoring is appropriate. If there are success standards for this year of the monitoring period, a report follows in this document. In other cases, qualitative monitoring was conducted, and the results communicated internally to the appropriate environmental manager. This feedback allows the site manager to conduct any corrective activities prior to the time that the next success standard will be quantitatively monitored.

Literature Cited

Bonham, C.D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons, New York, NY.

Canfield, R. H. 1941. Application of the Line Interception Method in Sampling Range Vegetation. J. For. 39:388-394.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Executive Order 89-10. Protection of Wetlands. December 11, 1989.

Horner, R. R. and K. J. Raedeke. 1989. Guide for Wetland Mitigation Project Monitoring - Operational Draft. Prepared for Washington State Transportation Commission, Department of Transportation, Olympia, Washington. WA-RD 195.1.

Krebs, C. J. 1999. Ecological Methodology, 2nd edition. Benjamin/Cummings, New York, NY.

Ossinger, M. 1999. Success Standards for Wetland Mitigation Projects – a Guideline. Washington State Department of Transportation, Environmental Affairs Office.

Zar, J.H. 1999. Biostatistical Analysis, 4th edition. Prentice-Hall, Inc., Upper Saddle River, NJ.

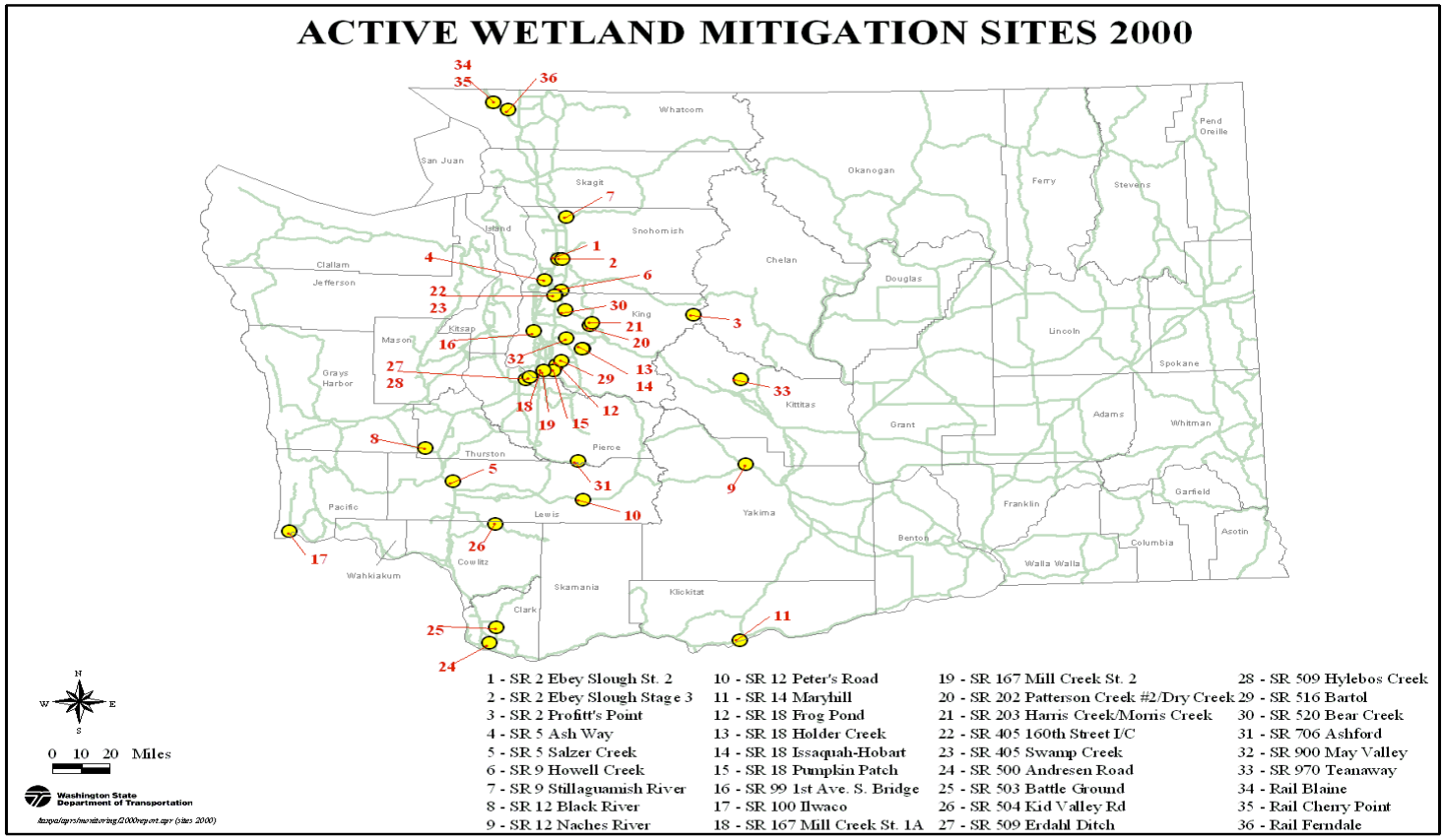

Figure 1: WSDOT Mitigation Sites Monitored in 2000

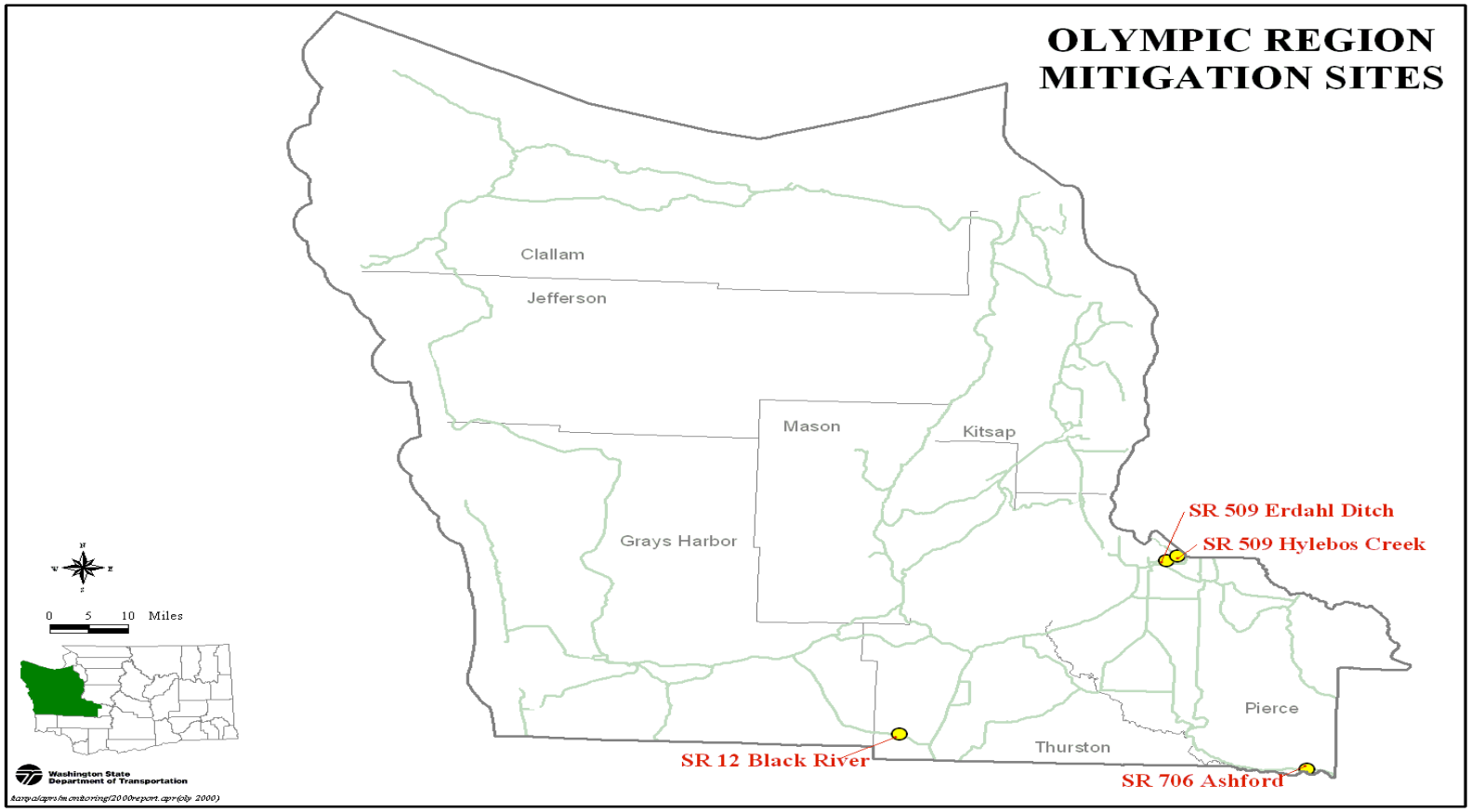

FIGURE 2: Olympic Region Mitigation Sites Monitored in 2000

SR12 Black River, Thurston County

The following report summarizes monitoring activities completed at the SR 12 Black River mitigation site during the summer 2000 by the Washington State Department of Transportation (WSDOT) Wetland Monitoring Program. Activities include vegetative cover surveys and survival estimates of planted woody species.

Site Information

Site Name	SR 12 Black River
Project Name	SR 12 Vicinity Black River Bridge & SR 12 Vicinity Moon Rd.
Permit Number	SSDP-98-0882
Permitting Agency	Thurston County Shoreline Permit
Location	SR 12 at Moon Road, Thurston County, WA
Monitoring Period	2000-2004
Year of monitoring	1 of 5
Area of project impact	0.8 ha (1.9 ac)
Type of mitigation	Wetland Creation
Area of mitigation	1.5 ha (3.8 ac)
Replacement Ratio	2:1

Management and Sampling Objectives

Monitoring tasks and associated management and sampling objectives were developed from the General Mitigation Strategy contained in the *SR 12 Vicinity Black River Bridge & SR 12 Vicinity Moon Road Combined Conceptual Wetland Mitigation Plan* (Russell 1998) and in consultation with regional staff and resource agencies. The complete text of the success standards is presented in Appendix A. Success standards, management objectives, and sampling objectives addressed this year are listed below.

Success Standard

Cover of reed canarygrass, or other invasive species may not exceed 20% of the total wetland area at any time during years one through five.

Management Objective 1

Limit aerial cover of invasive species to 20% or less at the SR12 Black River mitigation site from 2000-2004. [3]

[3] The invasive species of concern on this site include: *Phalaris arundinacea* (reed canarygrass), non-native *Rubus* sp. (blackberries), *Cytisus scoparius* (Scot's broom), *Senecio jacobaea* (tansy ragwort), *Hedera helix* (English ivy), *Lythrum salicaria* (purple loosestrife), *Spirea douglasii* (Douglas' spiraea), *Typha latifolia* (broad-leaf cattail), and other species as listed in the Thurston County Noxious Weed List and the State Noxious Weed List.

Sampling Objective 1
To be 80% confident the mean aerial cover estimate of invasive species is within 20% of the true cover value.

Success Standard
100% survival (or replacement) of trees and shrubs at the end of year one. Non-invasive volunteer species are acceptable in all zones and may be used in estimating percent cover of emergent species and credited toward survival of planted trees and shrubs.

Management Objective 2
Achieve 100% survival of planted woody species at the SR12 Black River mitigation site by 2000.

Sampling Objective 2
To be 80% confident the mean survival estimate for planted woody species is within 20% of the true survival value.

Success Standard
Vegetative success must equal or exceed 80% survival of planted trees and shrubs by the end of year three, or additional planting (and monitoring) to achieve such.

Management Objective 3
Measure density of planted woody species at the SR 12 Black River mitigation site in 2000.

Sampling Objective 3
To be 80% confident the mean density estimate for woody species is within 20% of the true density value.

Methods
Using a systematic random sampling method, 25 transects were located on the site. Each transect contained one 20-m sampling unit. The point intercept technique (Bonham 1989; Elzinga et al. 1998) was used to collect aerial cover data for herbaceous species along each sampling unit. Following a random start, point quadrats were systematically located along the transects. At each point location, a point intercept device was lowered vertically from above the tallest herbaceous vegetation on the west side of the transect tape. Each plant species intercepted by the point intercept device was recorded. If the point intercept device did not intercept vascular plant species, data was recorded as bare soil, non-vascular plant, or habitat structure.

Survival information for each planted woody species was obtained from randomly positioned, one-meter wide quadrats that were parallel and adjacent to each of the sample

units described above. An indication of vigor (alive or dead) was recorded for each individual within the sample unit. These data were evaluated to obtain an estimate of mean survival of planted woody species on the site.

The number of surviving plants for each quadrat was divided by the area of that quadrat to obtain mean density (in plants per square meter).

The following sample size equation was used to evaluate the number of sample units required to attain sampling objective one.

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[4]
n = unadjusted sample size

Results and Discussion

Data analysis showed the aerial cover of invasive species was approximately 7%. Due to the extremely low occurrence of these species, no confidence level can be associated with this estimate. A qualitative estimate was consistent with the quantitative estimate. Cover by invasive species will be monitored each year.

The mean survival for planted woody species was 97% (CI 0.95 ±0.08), and was consonant with visual estimates made in the field. This survival rate was slightly less than required by management objective two. However, we expect the unsuccessful plantings will be quickly replaced through natural colonization of desirable species. Photograph 1 in Appendix A shows a representative view of the planted area.

The mean density per sample unit was 0.87 stems per square meter (CI 0.90 ±0.09). This result will be used as a basis for comparison in future years for management objective three.

[4] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

Table 1. Estimates for management objectives show objectives have been achieved for survival and density of woody species in this zone. Invasive species cover was too low to report with statistically valid data.

SR 12 Black River	Invasive Species Cover (Management Objective 1)	Woody Species Survival (Management Objective 2)	Density (Management Objective 3)
Result	<10 %	97 %	0.87 stems per m^2
Management Objective	Achieved	Achieved	na
Dominant Species		*Cornus sericea*	
		Alnus rubra	
		Fraxinus latifolia	

Literature Cited

Bonham, C. D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons, New York, NY.

Canfield, R. H. 1941. Application of the Line Intercept Method in Sampling Range Vegetation. J. For. 39:388-394.

Driscoll, J. M. 1999. Findings, Conclusions and Decisions. Hearings Examiner of Thurston County. Shoreline Substantial Development Permit No. SSDP-98-0882.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Reed, P. B. Jr. 1993. Supplement to List of Plant Species that Occur in Wetlands: Northwest Region (Region 9). U. S. Fish and Wildlife Service Supplement to Biological Report 88 (26.9).

Russell, E. 1998. SR 12 Vicinity Black River Bridge & SR 12 Vicinity Moon Road Combined Conceptual Wetland Mitigation Plan. Washington State Department of Transportation Environmental/Hydraulic Services Office.

Appendix A

Monitoring tasks and associated management and sampling objectives were developed from the General Mitigation Strategy contained in the *SR 12 Vicinity Black River Bridge & SR 12 Vicinity Moon Road Combined Conceptual Wetland Mitigation Plan* (Russell 1998) and in consultation with Regional Staff. Formal success standards were not required by permitting agencies. The standards addressed this year are identified in **bold** font. Other standards will be addressed in the indicated monitoring year.

Informal Standards of Success

Standard #1: **100% survival (or replacement) of trees and shrubs at the end of year one. Non-invasive volunteer species are acceptable in all zones and may be used in estimating percent cover of emergent species and credited toward survival of planted trees and shrubs.**

Standard #2: Vegetative success must equal or exceed 80% survival of planted trees and shrubs by the end of year three, or additional planting (and monitoring) to achieve such.

Standard #3: Hydrology (within 12 inches of the soil surface) within the wetland creation area must be present for at least 12.5% of the growing season (consecutive).

Standard #4: Cover of reed canarygrass, or other invasive species may not exceed 20% of the total wetland area at any time during years one through five.

Photograph 1 - SR 12 Black River August 22, 2000

SR 12 Black River Plant List 2000

Species Name	Common Name	Status	Origin
Agrostis alba	redtop	FAC	Eur
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Alopecurus geniculatus	water foxtail	OBL	Intro
Beckmannia syzigachne	American sloughgrass	OBL	Native
Carex sp.	sedges	---	---
Cirsium vulgare	bull thistle	FACU	Eur
Daucus carota	Queen Anne's lace	NL	Eur
Deschampsia caespitosa	tufted hairgrass	FACW	Native
Epilobium ciliatum	hairy willow-herb	FACW-	Native
Geranium dissectum	cut-leaved geranium	NL	Eur
Glyceria borealis	northern manna grass	OBL	Native
Holcus lanatus	common velvet grass	FAC	Eur
Juncus bufonius	toad rush	FACW	Native
Juncus effusus	soft rush	FACW	Native
Juncus tenuis	slender rush	FACW-	Native
Lolium multiflorum	Italian ryegrass	NL	Eur
Lolium perenne	perennial ryegrass	FACU	Eur
Phalaris arundinacea	reed canarygrass	FACW	Nat & Intro
Phleum pratense	common timothy	FAC-	Intro
Physocarpus capitatus	Pacific ninebark	FACW-	Native
Plagiobothrys sp.	popcorn-flowers	---	---
Plantago lanceolata	English plantain	FAC	Eur
Plantago major	broadleaf plantain	FACU+	Native
Polygonum lapathifolium	willow-weed	FACW	Native
Populus balsamifera	black cottonwood	FAC	Native
Ranunculus repens	creeping butter-cup	FACW	Eur
Rorippa curvisiliqua	western yellow-cress	OBL	Native
Rumex crispus	curly dock	FAC+	Intro
Trifolium hybridum	alsike clover	FAC	Intro
Trifolium repens	white clover	FAC	Eur

SR 509 Erdahl Ditch, Pierce County

The following report summarizes project activities completed by the Washington State Department of Transportation (WSDOT) Wetland Monitoring Program at the SR 509 Erdahl Ditch wetland mitigation site in August 2000. Activities include vegetation and wildlife surveys. As specified in the *Department of the Army Permit* (USACE 1994), formal monitoring was conducted at the mitigation site this year.

Site Information

Site Name	SR 509 Erdahl Ditch
Project Name	SR 509 East-West Corridor
Permit Number	93-4-00148
Permitting Agency	USACE
Location	Pierce County, Washington
Township/Range/Section	T20N R35E S2
Monitoring Period	1996-2004
Year of Monitoring	5 of 9
Area of Project Impact	0.52 ha (1.27 ac)[5]
Type of Mitigation	Ditch relocation
Area of Mitigation	0.96 ha (2.73 ac)
Replacement Ratio	1.86:1

Management and Sampling Objectives

Monitoring objectives for the Erdahl Ditch relocation project were developed from success standards described in the *Wetland Mitigation Plan State Route 509 East-West Corridor* (WSDOT 1994) and *Department of Army Permit* (USACE 1994). The complete text of the success standards is presented in Appendix C. Success standards, management objectives, and sampling objectives addressed this year are listed below. Management objectives without corresponding sampling objectives are addressed in the methods section.

Success Standard

At the end of the monitoring period, (5 years) the shrub and tree planted areas of Erdahl Ditch and Hylebos sites will have a minimum of 80% average aerial cover that are appropriate to the sites and to its hydrologic regime.

Management Objective 1

Achieve 80% or greater aerial cover of tree and shrub species in planted areas of the SR 509 Erdahl Ditch mitigation site by 2004.

[5] WSDOT provides 0.96 ha (2.37 ac) of compensatory mitigation for project impacts to 0.52 ha (1.27 ac) of wetland along the State Route 509 East-West corridor. This total includes 0.005 ha (0.023 ac) of impact from the City of Tacoma Hylebos Waterway project. Compensation is provided at both the SR 509 Erdahl Ditch (0.18 ha/0.44 ac) and Hylebos Creek (0.78 ha/1.9 ac) mitigation sites (WSDOT 1994).

Sampling Objective 1
To be 80% confident mean aerial cover estimates for tree and shrub species are within 20% of the true species cover value.

Success Standard
At the end of the monitoring period, the Erdahl Ditch Tributary wetland seeding area should have a minimum of 90% aerial coverage of wetland species (FAC+ or wetter).

Management Objective 2
Achieve 90% or greater aerial cover of wetland species (FAC+ and wetter) in the wetland seeding area of the SR 509 Erdahl Ditch mitigation site by 2004.

Sampling Objective 2
To be 80% confident mean aerial cover estimate for wetland species in the wetland seeding area are within 20% of the true species cover value.

Success Standard
At the end of the monitoring period, the 90% areal cover of dense vegetation to be established in the Erdahl Ditch Tributary replacement wetland and the Hylebos Creek mitigation wetland shall include no more than 10% areal cover by non-native, invasive species.

Management Objective 3
Maintain aerial cover of all non-native, invasive plant species at a value equal to or less than 10% at the SR 509 Erdahl Ditch wetland mitigation site from 1996 to 2004.

Sampling Objective 3
To be 80% confident mean aerial cover estimates for all non-native, invasive plant species are within 10% of the true species cover value.

Success Standard
Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the wetland mitigation monitoring program. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located.

Management Objective 4
To provide wildlife habitat for species that utilize wetlands for some or all of their habitat requirements at the SR 509 Erdahl Ditch wetland mitigation site from 1996 to 2004.

Methods
A sampling macroplot (300m × 15m) was strategically positioned to include all planted wetland vegetation zones at the Erdahl Ditch mitigation site. A restricted random

sampling method was employed as the macroplot was divided into 20 equal segments along its longest side. Transects were randomly positioned within each segment perpendicular to the length of the macroplot. Both herbaceous and woody species cover data were collected along sampling transects.

Cover data for the woody species plant community was collected using the line-intercept method (Canfield 1941; Bonham 1989). All woody vegetation intercepting tape measures stretched along each sampling transect was identified and the length of the canopy intercept was recorded. To achieve the statistical confidence interval specified in sampling objectives one and two, 20 15-meter sample units were randomly placed along sampling transects in the planted vegetation zones.

For the herbaceous community, the point intercept technique (Bonham 1989; Elzinga et al. 1998) was used to collect aerial cover data for plant species. Following a random start, point quadrats were systematically placed along sampling transects through all vegetative zones. At each point location, a rod was dropped vertically from above the tallest herbaceous vegetation. All plant species touched by the rod were recorded. If the rod touched no vascular plant species, the data was recorded as bare soil, non-vascular plant, or habitat structure. To achieve the statistical confidence interval specified in sampling objective three, 600 data points along 20 randomly positioned sample units were collected in the planted vegetation zones.

Sample size analysis confirmed achievement of the sampling objectives. The following equation was used to perform this analysis:

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[6]
n = unadjusted sample size

Four bird surveys were conducted at the mitigation site from May through July. The point count method (Ralph et al. 1993) was used to document species presence and relative abundance.

Results and Discussion

Although some vegetation at the west end of the mitigation site has been cut, forest and scrub-shrub cover remains high.[7] Records show planted areas of the mitigation site support 87 percent (CI 0.95 ± 0.10) aerial cover of native forest and scrub-shrub species (Table 1). This value exceeds standards specified in the mitigation plan (Objective 1). Native wetland species (FAC+ and wetter) provide 85 percent (CI 0.95 ± 0.105) cover in this zone (Reed1993). Cover estimates approach the 90 percent standard set for 2004

[6] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

[7] Approximately 450m^2 of forest and scrub-shrub vegetation has been cut to improve signage visibility and exposure for a local business. Representatives from WSDOT have contacted the business proprietor.

(Objective 2). *Salix lucida* var. *lasiandra* (Pacific willow) and *Cornus sericea* (red-osier dogwood) dominate the woody species canopy with 79 percent (CI 0.80 ± 0.20) and 43 percent (CI 0.80 ± 0.20) aerial cover, respectively.

The combined aerial cover estimate for noxious and invasive species in the herbaceous plant community was 25 percent (CI 0.80 ± 0.22) (Table 1). This value exceeds the 10 percent threshold specified in the mitigation plan (Objective 3). Data indicates the presence of *Cytisus scoparius* (Scot's broom), *Phalaris arundinacea* (reed canarygrass), *Phragmites australis* (common reed), *Polygonum cuspidatum* (Japanese knotweed), and *Rubus armeniacus* (Himilayan blackberry) on the mitigation site.

Appendix B includes a list of plant species recorded during monitoring visits to the SR 509 Erdahl Ditch mitigation site in 2000.

In spite of its small size and location, this year's data record shows the bird community at the Erdahl Ditch mitigation site is diverse with 25 species from 13 avian families represented. Three wetland dependent species were recorded during bird surveys in 2000. These species were the Common Yellowthroat, Great Blue Heron, and Red-winged Blackbird (Thomas 1979, Erhlich et al. 1988, Smith et al. 1997). Other species known to use wetlands for feeding, breeding or nesting were observed on site this year. These species include the Barn Swallow, Wilson's Warbler, and Willow Flycatcher (Thomas 1979, Erhlich et al. 1988, Smith et al. 1997).

Values for bird species richness likely reflect vertical and horizontal structural development in the vegetative community at this site. In addition, planted *Mahonia aquifolium* (tall Oregon grape) provide a potential source of food for many bird species. These plants produced abundant fruit in July and August 2000. In July, a Song Sparrow nest with two chicks was observed in a willow thicket 30 meters east of the western boundary. These data indicate this site satisfies success criteria detailed in management objective 4.

Table 2: Cover estimates for species in the wetland seeding area show objectives have been achieved for native woody species in this zone. Invasive species cover exceeds the 10% standard.

Wetland Seeding Area	Woody Species (Objective 1)	Native Wetland Species (Objective 2)	Invasive Species (Objective 3)
Total Aerial Cover	**87 %**	**85 %**	**25 %**
Management Objective	Achieved		
Dominant Species	*Salix lucida*	*Salix lucida*	*Phalaris arundinacea*
	Cornus sericea	*Cornus sericea*	

Literature Cited

Bonham, C. D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons, New York, NY.

Canfield, R. H. 1941. Application of the Line Intercept Method in Sampling Range Vegetation. J. For. 39:388-394.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Erhlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The Birders Handbook. Simon and Schuster, Inc., New York.

Finch, D.M. 1989. Habitat use and habitat overlap of riparian birds in three elevational zones. Ecology 70 (4) 1866-880.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. Handbook of Field Methods for Monitoring Landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, Department of Agriculture.

Reed, P. B. Jr. 1993. Supplement to List of Plant Species that Occur in Wetlands: Northwest Region (Region 9). U. S. Fish and Wildlife Service Supplement to Biological Report 88 (26.9).

Smith, M. R., P. W. Mattocks, Jr., and K. M. Cassidy. 1997. Breeding Birds of Washington State. Volume 4 *in* Washington State Gap Analysis – Final Report (K. M. Cassidy, C. E. Grue, M. R. Smith, and K. M. Dvornich, eds.). Seattle Audubon Society Publications in Zoology No. 1, Seattle.

Thomas, J. W. (tech ed.). 1979. Wildlife Habitat in Managed Forests – the Blue Mountains of Oregon and Washington. USDA Forest Service, Agricultural Handbook No. 553.

United States Army Corps of Engineers. 1994. Department of the Army Permit. Number 93-4-00148.

Washington State Department of Transportation. 1994. Wetland Mitigation Plan State Route 509 East-West Corridor. Project number OL1363.

Appendix B

Photograph 2 – Erdahl Ditch representative view along the ditch July 26, 2000.

SR 509 Erdahl Ditch Plant List

Species Name	Common Name	Status	Origin
Agrostis alba	redtop	FAC	Eur
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Alnus rubra	red alder	FAC	Native
Berberis aquifolium	tall Oregon grape	NL	Native
Convolvulus arvensis	field morning glory	NL	Eur
Cornus sericea	red-osier dogwood	FACW	Native
Cytisus scoparius	Scotch broom	UPL	Intro
Epilobium ciliatum	hairy willow-herb	FACW-	Native
Equisetum palustre	marsh horsetail	FACW	Native
Equisetum telmateia	giant horsetail	FACW	Native
Galium aparine	cleavers	FACU	Native
Holcus lanatus	common velvet grass	FAC	Eur
Juncus effusus	soft rush	FACW	Native
Phalaris arundinacea	reed canarygrass	FACW	Nat & Intro
Phragmites australis	common reed	FACW+	Native
Polygonum cuspidatum	Japanese knotweed	FACU	Asia
Ranunculus repens	creeping butter-cup	FACW	Eur
Rubus armeniacus	Himalayan blackberry	FACU	Eur
Rubus ursinus	California dewberry	FACU	Native
Salix lucida	Pacific willow	FACW+	Native
Salix sitchensis	Sitka willow	FACW	Native
Solanum dulcamara	climbing nightshade	FAC+	Eur
Trifolium repens	white clover	FAC	Eur
Typha latifolia	broad-leaf cattail	OBL	Native

SR 509 Erdahl Ditch Bird List

Common Name	Scientific Name	Family Name	*Wetland Dependent
American Crow	*Corvus brachyrhynchos*	Corvidae	
American Goldfinch	*Carduelis tristis*	Fringillidae	
American Robin	*Turdus migratorius*	Turdidae	
Barn Swallow	*Hirundo rustica*	Hirundinidae	
Black-capped Chickadee	*Parus atricapillus*	Paridae	
Brown-headed Cowbird	*Molothrus ater*	Icteridae	
Cedar Waxwing	*Bombycilla cedrorum*	Bombycillidae	
Cliff Swallow	*Hirundo pyrrhonota*	Hirundinidae	
Common Yellowthroat	*Geothlypis trichas*	Emberizidae	X
Dark-eyed Junco	*Junco hyemalis*	Emberizidae	
European Starling	*Sturnus vulgaris*	Sturnidae	
Great Blue Heron	*Ardea herodias*	Ardeidae	X
House Finch	*Carpodacus mexicanus*	Fringillidae	
House Sparrow	*Passer domesticus*	Passeridae	
Northern Flicker	*Colaptes auratus*	Picidae	
Red-winged Blackbird	*Agelaius phoeniceus*	Icteridae	X
Savannah Sparrow	*Passerculus sandwichensis*	Emberizidae	
Song Sparrow	*Melospiza melodia*	Emberizidae	
Spotted Towhee	*Pipilo maculatus*	Emberizidae	
Steller's Jay	*Cyanocitta stelleri*	Corvidae	
Swainson's Thrush	*Catharus ustulatus*	Turdidae	
Violet-green Swallow	*Tachycineta thalassina*	Hirundinidae	
White-crowned Sparrow	*Zonotrichia leucophrys*	Emberizidae	
Willow Flycatcher	*Empidonax traillii*	Tyrannidae	
Wilson's Warbler	*Wilsonia pusilla*	Emberizidae	

** Wetland dependent species are those that are considered restricted in temporal or spatial distribution to wetlands based on an intrinsic feature or features of the environment* (Finch 1989).

SR 509 Hylebos Creek, Pierce County

The following report summarizes project activities completed by the Washington State Department of Transportation (WSDOT) Wetland Monitoring Program at the SR 509 Hylebos Creek wetland mitigation site in August 2000. Monitoring on this site included vegetation and bird surveys. As specified in the *Department of the Army Permit* (USACE 1994), formal monitoring was conducted at the mitigation site this year.

Site Information

Site Name	SR 509 Hylebos Creek
Project Name	SR 509 East-West Corridor
Permit Number	93-4-00148
Permitting Agency	USACE
Location	Pierce County, Washington
Township/Range/Section	T20N R35E S2
Monitoring Period	1996-2004
Year of Monitoring	5 of 9
Area of Project Impact	0.52 ha (1.27 ac)[1]
Type of Mitigation	Creation/Restoration
Area of Mitigation	0.96 ha (2.37 ac)
Replacement Ratio	3:1

Management and Sampling Objectives

Monitoring objectives for Hylebos Creek creation/restoration project were developed from success standards described in the *Wetland Mitigation Plan, State Route 509 East-West Corridor* (WSDOT 1994) and Department of Army Permit (USACE 1994). The complete text of the success standards is presented in Appendix B. Success standards, management objectives, and sampling objectives addressed this year are listed below. For management objectives without a corresponding sampling objective, a monitoring strategy is described in the methods section.

Success Standard

At the end of the monitoring period, (5 years) the shrub and tree planted areas of Erdahl Ditch and Hylebos sites will have a minimum of 80% average aerial that are appropriate to the sites and to its hydrologic regime.

Management Objective 1

Achieve 80% or greater aerial cover of tree and shrub species in the planted areas of the SR 509 Hylebos Creek mitigation site by 2004.

[1] WSDOT provides 0.96 ha (2.37 ac) of compensatory mitigation for project impacts to 0.52 ha (1.27 ac) of wetland along the State Route 509 East-West corridor. This total includes 0.005 ha (0.023 ac) of impact from the City of Tacoma Hylebos Waterway project. Compensation is provided at both the SR 509 Erdahl Ditch (0.18 ha/0.44 ac) and Hylebos Creek (0.78 ha/1.9 ac) mitigation sites (WSDOT 1994).

Sampling Objective 1
To be 80% confident the mean aerial cover estimate for tree and shrub species is within 20% of the cover value.

Success Standard
At the end of the monitoring period, the 90% areal cover of dense vegetation to be established in the Erdahl Ditch Tributary replacement wetland and the Hylebos Creek mitigation wetland shall include no more than 10% areal cover by non-native, invasive species.

Management Objective 2
Maintain aerial cover of all non-native, invasive plant species at a value equal to or less than 10% at the SR 509 Hylebos Creek wetland mitigation site between 1996 and 2004.

Sampling Objective 2
To be 80% confident the mean aerial cover estimate for all non-native, invasive plant species is within 10% of the true cover value.

Success Standard
Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the wetland mitigation monitoring program. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located.

Management Objective 3
To provide wildlife habitat for species that utilize wetlands for some or all of their habitat requirements at the SR 509 Hylebos Creek wetland mitigation site between 1996 and 2004.

Methods
Two temporary macroplots were established within the site boundaries. Transects for each macroplot were located using a systematic random sampling method and were extended perpendicular to a baseline. The 130-m baseline for Macroplot A was established along the western fence line and 26 transects were extended to the stream. The 160-m baseline of Macroplot B was placed along the western fence line south of macroplot A and 39 transects were extended to the intertidal area. Woody and herbaceous species data were collected along each transect in the macroplots.

Cover data for the woody species plant community was collected using the line-intercept method (Canfield 1941; Bonham 1989). All woody vegetation intercepting tape measures stretched along each sampling transect was identified and the length of the canopy intercept was recorded. To achieve the statistical confidence interval specified in sampling objective one, 26 sample units of 20-m each were randomly placed along

sampling transects in Macroplot A. Thirty-nine sample units of 4.5-m each were randomly placed along sampling transects in Macroplot B.

The point intercept technique (Bonham 1989: Elzinga et al. 1998) was used to collect aerial cover data for non-native, invasive species. Following a random start, point quadrats were systematically placed at 1m intervals along sampling transects through all vegetative zones. At each point location, a rod was lowered vertically from above the tallest herbaceous vegetation. All plant species touched by the rod were recorded. If the rod touched no vascular plant species, the data was recorded as bare soil, non-vascular plant, or habitat structure. To achieve the statistical confidence interval specified in sampling objective two, 26 sample units with 23-24 points each were randomly placed along transects in Macroplot A, and 58 sample units with 12 points each were randomly placed on Macroplot B.

Sample size analysis confirmed achievement of the sampling objectives. The following equation was used to perform this analysis:

$$n = \frac{(z)^2 (s)^2}{(B)^2}$$

z = standard normal deviate
s = sample standard deviation
B = precision level[9]
n = unadjusted sample size

Results and Discussion

The aerial cover estimate of tree and shrub species is 74% (CI 0.90 ± 0.10) in Macroplot A, and 52% (CI 0.80 ± 0.18) in macroplot B (Table 1). These values indicate that planted areas on site are developing as intended and should meet the 80% cover criteria specified in sampling objective one by year 2004.

The aerial cover estimate of non-native, invasive species in both Macroplot A and B is 18% (CI 0.80 ± 0.20) (Table 3). This value exceeds the threshold value of 10% specified in management objective two. Species of concern include *Cytisus scoparius* (Scotch Broom), *Phragmities australis* (common reed), *Rubus armeniacus* (Himalayan blackberry), *Phalaris arundinacea* (reed canarygrass), *Cirsium arvense* (Canadian thistle), *Cirsium vulgare* (bullthistle), *Convolvulus arvensis* (morning glory), and *Iris pseudacorus* (yellow flag). Regional managers have been contacted and appropriate management activities are being considered.

Appendix C includes a list of plant species recorded during monitoring visits to the SR 509 Hylebos Creek mitigation site in 2000.

This year's data records show the bird community at Hylebos is diverse with 23 species from 13 avian families. The seven wetland-dependent species recorded during bird

[9] The precision level equals half the maximum acceptable confidence interval width multiplied by the sample mean.

surveys in 2000 were the Great Blue Heron, Canada Goose, Mallard, Spotted Sandpiper, Sanderling, Belted Kingfisher and Common Yellowthroat (Thomas 1979, Erhlich et al. 1988, Smith et al. 1997). Other species known to use wetlands for feeding, breeding or nesting were also observed on site. These species include the Willow Flycatcher, Barn Swallow, and Wilson's Warbler. Killdeer populations are high with immature and mature birds present. Spotted Sandpipers, Sanderlings, Killdeer and other bird species were observed using the large tidal flat area for feeding. These data indicate this site satisfies management objective 3.

Table 3. Cover estimates for tree and shrub species in the planted areas are approaching the 80% cover success criteria for year 2004.

Trees and Shrubs (Management Objective 1)	Macroplot A	Macroplot B
Total Aerial Cover	74%	52%
Required cover in year 2004	80%	80%
Dominant Species	*Rosa* sp.	*Salix* sp.
		Rubus armeniacus

Literature Cited

Bonham, C. D. 1989. Measurements for Terrestrial Vegetation. John Wiley & Sons, New York, NY.

Canfield, R. H. 1941. Application of the Line Intercept Method in Sampling Range Vegetation. J. For. 39:388-394.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Erhlich, P. R., D. S. Dobkin, and D. Wheye. 1988. The Birders Handbook. Simon and Schuster, Inc., New York.

Finch, D.M. 1989. Habitat use and habitat overlap of riparian birds in three elevational zones. Ecology 70 (4) 1866-880.

Ralph, C. J., G. R. Geupel, P. Pyle, T. E. Martin, and D. F. DeSante. 1993. Handbook of Field Methods for Monitoring Landbirds. Gen. Tech. Rep. PSW-GTR-144. Albany, CA: Pacific Southwest Research Station, Forest Service, Department of Agriculture.

Reed, P. B. Jr. 1993. Supplement to List of Plant Species that Occur in Wetlands: Northwest Region (Region 9). U. S. Fish and Wildlife Service Supplement to Biological Report 88 (26.9).

Smith, M. R., P. W. Mattocks, Jr., and K. M. Cassidy. 1997. Breeding Birds of Washington State. Volume 4 *in* Washington State Gap Analysis – Final Report (K. M. Cassidy, C. E. Grue, M. R. Smith, and K. M. Dvornich, eds.). Seattle Audubon Society Publications in Zoology No. 1, Seattle.

Thomas, J. W. (tech ed.). 1979. Wildlife Habitat in Managed Forests – the Blue Mountains of Oregon and Washington. USDA Forest Service, Agricultural Handbook No. 553.

United States Army Corps of Engineers. 1994. Department of the Army Permit. Number 93-4-00148.

Washington State Department of Transportation. 1994. Wetland Mitigation Plan State Route 509 East-West Corridor. Project number OL1363.

Appendix C

The following excerpt is from the *Wetland Mitigation Plan State Route 509 East-West Corridor* (WSDOT 1994). This mitigation plan applies to both the SR 509 Erdahl Ditch and SR 509 Hylebos Creek mitigation sites. The standards addressed this year are identified in **bold** font. Other standards will be addressed in the indicated monitoring year.

Goals, Objectives, and Standards of Success

The mitigation package for these sites has several broad-based goals. First is the creation of the physical environment necessary to support and promote the development of wetland characteristics. The second goal is to establish wetland functions and values that either will be lost due to construction of the roadway or are limited in the region due to past practices. The most important of these functions and values include water quality treatment and habitat.

The wetland mitigation plan will create and enhance the general wetland functional values at the sites. General functional categories and the anticipated values attributable to these categories as a result of the mitigation project are as follows.

Wildlife

These wetland areas should provide some habitat for wildlife species, principally birds and small mammals. None of the sites, because of their locations in an urban setting will be suitable for large mammals except for possible transient usage. The plant species selected will provide a food resource for wildlife species.

The wetlands will be suitable for some species of amphibians. The Hylebos site, because of its connection to the creek, will be of some value to fisheries.

Hydrology/Water quality

Water quality functions are the most important function of the existing wetlands within the corridor. The mitigation plan is primarily designed to replace any lost water quality treatment values resulting from the fills. The mitigation for the railroad pond should actually improve the water quality function over the existing pond value. Dense stands of vegetation will be established to facilitate the treatment of water within the wetlands. The vegetation will help attenuate flows and provide sediment trapping capability.

Human values:

The development of wetlands on these sites by WSDOT will preclude the use of these areas for its current economic value (industrial and commercial use). Public access will not be available at these sites and there will be no way for the public to access the wetlands from the road.

Objective #1:
Construct the mitigation sites concurrently with roadway construction with completion no later than one year after project construction. If possible, the contractor should schedule the mitigation as one of the first tasks.

Success Criteria:
Completion as per objective.

Objective #2:
Increase the acreage of wetlands in the Tacoma tide flat region.

Success Criteria
Following five years of development and growth, the created wetland acreage within the mitigation sites, as delineated using the 1987 Corps manual, should exceed the acreage of the impacted wetlands.

Wetland acreage at the Blair Ditch Tributary should equal or exceed 0.44 of an acre.
Wetland acreage at the Hylebos mitigation site should equal or exceed 1.93 acres.

Objective #3:
Establish wetland and upland vegetation composition with appropriate structure.

Success Criteria:
At the end of the third year following the construction of the mitigation sites, aerial coverage shall exceed 50%.

At the end of the monitoring period, (5 years) the shrub and tree planted areas of Erdahl Ditch and Hylebos sites will have a minimum of 80% average aerial that are appropriate to the sites and to its hydrologic regime.

At the end of the monitoring period, the Erdahl Ditch Tributary wetland seeding area should have a minimum of 90% aerial coverage of wetland species (FAC+ or wetter).

The Hylebos mitigation site Lyngby's sedge planting area should have 50% aerial coverage of native wetland species at the end of the monitoring period.

Objective #4:
The wetland mitigation sites should provide wildlife habitat.

Success Criteria:
Development of habitat diversity and structure will be determined by the diversity and numbers of wetland dependent species identified during the wetland mitigation monitoring program. The sites will meet this objective if wildlife species that utilize wetlands for some or all of their habitat requirements are located.

Objective 5:
Creation of conditions in the Erdahl Ditch Tributary for water quality treatment that enhances it for this function.

Success Criteria
Dense vegetation establishment in the wetland (≥90% aerial coverage) within the monitoring period.

Establishment within monitoring period of stable upland side slopes with a maximum 2:1 grade and dense buffer vegetation (greater than 80% aerial coverage).

Objective #6:
Limit potential for contamination from the former UST site located at the Hylebos mitigation site.

Success Criteria:
Containment and removal of any contaminated soils found during grading activities at the Hylebos mitigation site.

Additional Permit Requirements (USACE 1994):
At the end of the monitoring period, the 90% areal cover of dense vegetation to be established in the Erdahl Ditch Tributary replacement wetland and the Hylebos Creek mitigation wetland shall include no more than 10% areal cover by non-native, invasive species.

Photograph 3 - SR 509 Hylebos Creek representative view of mud flat, tidal channel, and shrub-scrub areas August 22, 2000.

SR 509 Hylebos Creek Plant List 2000

Species Name	Common Name	Status	Origin
Acer macrophyllum	bigleaf maple	FACU	Native
Achillea millefolium	common yarrow	FACU	Native
Agrostis alba	redtop	FAC	Eur
Agrostis capillaris	colonial bentgrass	FAC	Eurasia
Aira caryophyllea	silver hairgrass	NL	Eur
Alnus rubra	red alder	FAC	Native
Amelanchier alnifolia	Saskatoon service-berry	FACU	Native
Aster eatonii x subspicatus	Eaton aster	NL	Native
Asteraceae	aster family (composites)	---	
Carex lyngbyei	Lyngby sedge	OBL	Native
Cirsium arvense	Canada thistle	FACU+	Eur
Cirsium vulgare	bull thistle	FACU	Eur
Convolvulus arvensis	field morning glory	NL	Eur
Cytisus scoparius	Scotch broom	UPL	Intro
Daucus carota	Queen Anne's lace	NL	Eur
Deschampsia caespitosa	tufted hairgrass	FACW	Native
Distichlis spicata	seashore saltgrass	FACW	Native
Eleocharis palustris	common spikerush	OBL	Native
Elytrigia repens	quackgrass	FAC-	Eurasia
Epilobium angustifolium	fireweed	FACU+	Native
Epilobium ciliatum	hairy willow-herb	FACW-	Native
Equisetum arvense	field horsetail	FAC	Native
Equisetum telmateia	giant horsetail	FACW	Native
Fraxinus latifolia	Oregon ash	FACW	Native
Galium aparine	cleavers	FACU	Native
Geranium dissectum	cut-leaved geranium	NL	Eur
Holcus lanatus	common velvet grass	FAC	Eur
Hypochaeris radicata	spotted cat's-ear	FACU	Eur
Iris pseudacorus	yellow flag	OBL	Intro
Leontodon hirtus	hairy hawkbit	NL	Eur
Mahonia aquifolium	tall Oregon grape	NL	Native
Parentucellia viscosa	yellow parentucellia	FAC-	Intro
Phalaris arundinacea	reed canarygrass	FACW	Nat & Intro
Phragmites australis	common reed	FACW+	Native
Picea sitchensis	Sitka spruce	FAC	Native
Plantago lanceolata	English plantain	FAC	Eur
Rosa sp.	Rose	---	
Rubus armeniacus	Himalayan blackberry	FACU	Eur

SR 509 Hylebos Creek Plant List 2000 (Continued)

Species Name	Common Name	Status	Origin
Rumex crispus	curly dock	FAC+	Intro
Salicornia virginica	Virginia glasswort	OBL	Native
Salix sitchensis	Sitka willow	FACW	Native
Salix sp.	willows	---	
Sambucus racemosa	red elderberry	FACU	Native
Scirpus acutus	hardstem bulrush	OBL	Native
Solanum dulcamara	climbing nightshade	FAC+	Eur
Solidago canadensis	Canada golden-rod	FACU	Native
Vicia hirsuta	hairy vetch	NL	Eur
Vicia sativa	common vetch	UPL	Intro

SR 509 Hylebos Creek Bird List

Common Name	Scientific Name	Family Name	*Wetland Dependent
American Goldfinch	*Carduelis tristis*	Fringillidae	
American Robin	*Turdus migratorius*	Turdidae	
Barn Swallow	*Hirundo rustica*	Hirundinidae	
Belted Kingfisher	*Ceryle alcyon*	Alcedinidae	X
Brewer's Blackbird	*Euphagus cyanocephalus*	Icteridae	
Brown-headed Cowbird	*Molothrus ater*	Icteridae	
Canada Goose	*Branta canadensis*	Anatidae	X
Cedar Waxwing	*Bombycilla cedrorum*	Bombycillidae	
Cliff Swallow	*Hirundo pyrrhonota*	Hirundinidae	
Common Yellowthroat	*Geothlypis trichas*	Emberizidae	X
European Starling	*Sturnus vulgaris*	Sturnidae	
Great Blue Heron	*Ardea herodias*	Ardeidae	X
House Finch	*Carpodacus mexicanus*	Fringillidae	
Killdeer	*Charadrius vociferus*	Charadriidae	
Mallard	*Anas platyrhynchos*	Anatidae	X
Sanderling	*Calidris alba*	Scolopacidae	X
Song Sparrow	*Melospiza melodia*	Emberizidae	
Spotted Sandpiper	*Actitis macularia*	Scolopacidae	X
Tree Swallow	*Tachycineta bicolor*	Hirundinidae	
Violet-green Swallow	*Tachycineta thalassina*	Hirundinidae	
White-crowned Sparrow	*Zonotrichia leucophrys*	Emberizidae	
Willow Flycatcher	*Empidonax traillii*	Tyrannidae	
Wilson's Warbler	*Wilsonia pusilla*	Emberizidae	

**** Wetland dependent species are those that are considered restricted in temporal or spatial distribution to wetlands based on an intrinsic feature or features of the environment*** **(Finch 1989).**

Glossary of Terms

Abundance (total) – the total number of individuals, cover, frequency of occurrence, volume, or biomass of a species, or group of species, within a given area.

Accuracy – the closeness of a measured or computed value to its true value.

Adaptive management – the process of linking ecological management within a learning framework.

Aerial cover - is the amount of ground covered by vegetation of a particular species or suite of species when viewed from above. Aerial cover is generally expressed as a percentage. This is typically obtained from herbaceous plot, point intercept, or line intercept data.

Areal estimates - are made using the mapped boundary of a feature as viewed from above. Areal estimates are a measure of area recorded as a number from 0 to 100, and not as a fraction or percent (Hruby et al. 1999). Compare this to the definition of percent cover.

Aquatic vegetation - includes submerged rooted (includes *Elodea, Characeae, Myriophyllum*) or floating non-rooted aquatic plants (includes *Lemna, Azolla, Wolfia*). For compliance purposes, these plants are not included in cover estimates.[10]

Bare ground - an area that can support, but does not presently support vascular vegetation (for compliance purposes, bare ground may include areas covered by cryptogams).

Benthic community - life in or on the sediments of a body of water.

Biological monitoring – the acquisition of information to assess the status and trend in status of the structure and functioning of biological populations and communities, and their habitat, and larger-scale ecological systems over time for the purpose of assessing and directing management activities (Elzinga et al. 1998).

Biological population – all of the individuals of one or more species within a prescribed area at a particular time.

Confidence interval (CI) – is an estimate of precision around a sample mean. A confidence interval includes confidence level and confidence interval half-width.

[10] For compliance purposes, vascular floating-leaved plants are included in cover estimates (e.g., *Nuphar, Potamogeton*).

Glossary (continued)

Canopy cover - the coverage of foliage canopy (herbaceous or woody species) per unit ground area.

Community - a group of populations of species living together in a given place and time.

Cryptogam - any of the *Cryptogamia*, an old primary division of plants comprising those without true flowers and seeds including ferns, mosses, and thallophytes (algae, fungi, and lichen).

Density – the number of individuals, stems, or other counting unit per unit area.

Ecotone - the boundary or transitional zone between adjacent communities.

Emergent plants - erect, rooted, herbaceous angiosperms that may be temporarily to permanently flooded at their base but do not tolerate prolonged inundation of the entire plant.

Floating plant - a non-anchored plant that floats freely in the water or on the water surface.

Floating-leaved plant - a rooted, herbaceous hydrophyte with some leaves floating on the water surface.

Herbaceous - with characteristics of an herb; an annual, biennial, or perennial plant that is leaflike in color or texture, or not woody.

Herbaceous cover - is the estimated aerial cover of herbaceous vegetation on a mitigation site; generally expressed as a percentage. Specifically, it is the proportion of ground covered by the herbaceous layer relative to the proportion of bare ground.

Hydric soils - soils formed under the conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part (Federal Register 1994).

Line transect – a transect for which the sampling unit is, theoretically, a line with no width.

Macroplot – usually refers to a relatively large sampling area in which subsampling will be conducted, often using quadrats and/or transects.

Management objective – a clear description of a measurable standard, desired state, threshold value, amount of change, or trend that you are trying to achieve for a particular population or habitat characteristic (Elzinga et al. 1998).

Glossary (continued)

Mud flat - a level landform composed of unconsolidated sediments. A mud flat may be irregularly shaped or elongate and continuous with the shore, whereas bars are generally elongate, parallel to the shore, and separated from the shore by water (Cowardin et al. 1979).

Open water - an area intended to be non-vegetated and permanently inundated as described in the site mitigation or planting plan.

Plot - a general term applied to any size of a circumscribed sampling unit for vegetation.

Point frame – is a linear, square, or rectangular quadrat that consists of a number of points used to collect vegetation data.

Point quadrat (points) – is a plot with a very small area, a single point, used to collect vegetation data. The point quadrat is theoretically dimensionless.

Population (biological) – all individuals of one or more species within a specific area at a particular time.

Population (statistical) - the complete set of individual objects (sampling units) about which you want to make inferences.

Precision – the closeness of repeated measurements of the same quantity.

Quadrat - an area delimited for sampling flora or fauna; the sampling frame itself.

Random sampling – sampling units drawn randomly from the population of interest.

Relative abundance (birds) – the number of individuals per unit of sampling effort.

Restricted random sampling – a sampling method that divides the population of interest into equal-sized segments. In each segment, a single sampling unit is randomly positioned. Sampling units are then analyzed as if they were part of a simple random sample.

Sample – a subset of the total possible number of sampling units in a statistical population.

Sample standard deviation – a value indicating how similar each individual observation is to the sample mean.

Sample statistics – are descriptive measures that are estimates of population parameters.

Glossary (continued)

Sampling – the act or process of selecting a part of something with the intent of showing the quality, style, or nature of the whole.

Sampling objective – a clearly articulated goal for the measurement of an ecological condition or change value (Elzinga et al. 1998).

Sampling units – the individual objects that collectively make up a statistical population, e.g., an individual plant, quadrats (plots), points, or transects (lines).

Standard deviation (SD) – a measure of how similar each individual observation is to the overall mean value.

Shrub - a woody plant which at maturity is usually less than 6m (20 feet) tall and generally exhibits several erect, spreading, or prostrate stems and has a bushy appearance (Cowardin et al. 1979). The species categories in this report follow Cooke (1997).

Species richness (birds) - the total number of bird species observed on a site.

Species richness (plant) - is the total number of species recorded on a site (herbaceous and woody).

Structures - any structure that is not expected to support vegetation in the short-term (during the monitoring period). These structures may include habitat structures, rocks, and other artifacts.

Systematic Random Sampling – the regular placement of quadrats, points, or lines along a sampling transect following a random start.

Transect - a line or narrow belt to survey the distributions or abundance of organisms across an area.

Tree - a woody plant that at maturity is usually 6m (20 feet) or more in height and generally has a single trunk, unbranched for 1m or more above ground, and more or less definite crown (Cowardin et al. 1979). The species categories in this report follow Cooke, 1997.

Vegetation structure - the physical or structural description of the plant life, e.g. the relative biomass (cover) in canopy layers; generally independent of particular species composition.

Wetland-dependent species (birds) - restricted in temporal or spatial distribution to wetlands based on an intrinsic feature or features of the environment (Finch, 1989).

Literature Cited

Cooke, S. S., (ed.). 1997. A Field Guide to the Common Wetland Plants of Western Washington and Northwestern Oregon. Seattle Audubon Society.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, Washington, D.C.

Elzinga, C. L., D. W. Salzer, and J. W. Willoughby. 1998. Measuring and Monitoring Plant Populations. Bureau of Land Management Technical Reference 1730-1, BLM/RS/ST-98/005+1730.

Federal Register. July 13, 1994. Changes in Hydric Soils of the United States. Washington, DC. (current Hydric Soil Definition).

Finch, D. M. 1989. Habitat Use and Habitat Overlap of Riparian Birds in Three Elevational Zones. Ecology 70 (4): 866-880.

Hruby, T., T. Granger, and E. Teachout. 1999. Methods for Assessing Wetland Functions. Volume I: Riverine and Depressional Wetlands in the Lowlands of Western Washington. Part 2: Procedures for Collecting Data. Washington State Department of Ecology Publication #99-116, Olympia, Washington.